



SOLID WASTE MANAGEMENT DIAGNOSIS OF GUAYAQUIL HISTORICAL PARK

DIAGNÓSTICO DEL MANEJO DE RESIDUOS SÓLIDOS EN EL PARQUE HISTÓRICO GUAYAQUIL

Alejandra Mora Cervetto y Natalia Molina Moreira*

Universidad Espíritu Santo, Av. Samborondón, Samborondón 092301, Ecuador.

*Author for correspondence: natimolina4@gmail.com

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Abstract

This study was performed in Parque Historico Guayaquil (PHG), to diagnose waste management practices undertaken in said establishment. It was accomplished through the characterization of waste generation, verification of its management according to environmental regulations, and by recommending alternatives for its optimum management. Qualitative and quantitative methods with a descriptive scope were used during research. Information was gathered through visits and interviews with key individuals. Measurements were taken during eight weeks and identification was performed through a one-time sampling following national and international guidelines. Non-hazardous wastes reported an average of 452 kg and showed a direct relation between generation and the number of visitors. The one-time samplings for hazardous and special waste were reported at 7.5 kg and 20 kg respectively. Characterization by category corresponded to 5% to hazardous waste, 12% special waste and 83% non-hazardous waste. This last result yielded in 45% of organic, 27% recyclables and 11% non-recyclables. The evaluation of environmental regulations revealed 36% compliance; therefore, PHG should consider resuming and implementing procedures that trigger comprehensive waste management as well as obtaining environmental permits. Waste generation's impacts should focus not only in quantity but also in type and management practices. PHG has the infrastructure as well as the potential to turn into a replicable waste management model.

Keywords: Waste treatment, waste recycling, environmental legislation, environmental management.

Resumen

Se realizó un diagnóstico del manejo de residuos sólidos del Parque Histórico Guayaquil (PHG) para determinar la generación de residuos sólidos, verificar su gestión con base en la normativa y proponer alternativas viables para un adecuado manejo, utilizando métodos cualitativo y cuantitativo con alcance descriptivo. Se realizaron entrevistas a actores clave. Los residuos se cuantificaron durante ocho semanas y la identificación cualitativa se realizó con un muestreo puntual y lineamientos de normas nacionales e internacionales. Los desechos no peligrosos registraron 452 kg en promedio semanal y mostraron una relación directa con el número de visitantes. Los desechos peligrosos pesaron 7.5 kg y los especiales 20 kg. Las categorías por tipo de residuo fueron: 5% peligrosos, 12% especiales y 83% no peligrosos. De éstos, el 45% corresponde a orgánicos, 27% a reciclables y el 11% a no reciclables. Se determinó un 36% de cumplimiento de 70 aspectos evaluados de la normativa ambiental aplicable, por lo que se debe implementar la gestión de residuos y obtener los permisos ambientales. El impacto ambiental por la generación de desechos no debería enfocarse en la cantidad sino en su tipo y manejo. El PHG cuenta con infraestructura y potencial para convertirse en un modelo de gestión replicable.

Palabras claves: Tratamiento de residuos, reciclaje de desechos, legislación ambiental, gestión ambiental.

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1 Introduction

1.1 Background

The Historical Park Guayaquil (PHG) is a natural, educational, recreational, tourist and cultural area that opened its doors to the public in 1999, under the administration of the Central Bank of Ecuador (Public Company of Urban Parks and Public Spaces, 2012). At the beginning of 2016, the Service of Public Sector Management acquires the powers of this administration (Public Sector Real Estate Management Service, 2016). Admission is free, unlike its start when the fee ranged between 2,00 and 4.50 (Idrovo et al., 2010).

The PHG maintains different areas: the Wildlife Area where ecosystems characteristic of the Old Province of Guayaquil have been recreated (Historical Park Guayaquil, 2014). The Urban Architectural Zone simulates the lifestyle in Guayaquil during the beginning of the 20th century and the Zone of Traditions represents the rural area of the coastal region (EPPUEP, 2012). The facility has a space for composting, premises for buying and selling food to the public, offices of the administrative staff and a dining room for staff. There are also sites for the maintenance of the PHG: nurseries, tool, materials and equipment storage room, two areas for the storage of wastes and the quarantine space that includes an operating room for the care of the animals (Ecoeficiencia, 2008).

The PHG is one of the main tourist sites in the city. As a result of visits and maintenance and cleaning activities, waste is generated that require comprehensive management in line with the policies of the PHG and national legislation. Proposing an integrated waste management initiative can make the PHG an example of good environmental and sanitary practices, making it a replicable model.

The PHG has an Integral Solid Waste Management Plan in which a daily generation of 125 kg corresponding to non-hazardous organic residues (animal food waste, feces, trail sweeping) and recyclable materials was reported. Hazardous wastes reported a generation of 4.2 kg, from the care of animals (infectious, anatomo-pathological, and short-stabbing), and maintenance activities. It was also established that most of these wastes had final disposal through the municipal toilet service and some were recycled or used within the PHG. Waste management shortcomings were related to inadequate

signaling of litter bins, storage conditions, lack of internal classification and inadequate management of hazardous wastes (Ecoeficiencia, 2008).

1.2 Integrated waste management in Ecuador

In Ecuador, waste is defined as the substance or composite material resulting from a process of production, processing, recycling, use or consumption, the elimination or disposal of which is in accordance with the applicable national and international environmental legislation (Ministry of the Environment of Ecuador, 2015). These can in turn be defined as: non-hazardous wastes generated by consumption or use in domestic, industrial, commercial, institutional or service activities, which are of no use to the generator, but which are fit to be harvested and processed in goods and products with added value to prolong their life. Hazardous waste is those that present characteristics of dangerousness (corrosive, reactive, toxic, flammable, bio-hazardous) in an excessive level to the concentration parameters established in the environmental regulations. Or special waste those that do not present characteristics of danger, but that by their nature, volume of generation or difficulty of degradation, have a potential to generate a negative impact on the environment and health, reason why their handling requires a treatment different from the non-dangerous (MAE, 2015).

The society demands a waste management that, besides being safe, is sustainable for the conservation of resources and the prevention of environmental pollution. (Chandrappa and Das, 2012, White et al., 2012). For this reason, the concept of a comprehensive management system is proposed, which seeks to minimize the impact, solve problems in different phases of management and comply with regulations. In addition, it can be controlled and monitored in order to obtain information for decision-making and to establish regulatory measures (Chandrappa and Das, 2012, Ministry of Environment of Peru, 2015, Paya, 2016).

The phases of integrated waste management are minimization, generation, separation at source, storage, recollection, harvesting or treatment, and final disposal (Williams, 2013, MAE, 2015).

The generation of waste is the amount of waste that a natural or legal person generates in a given time interval. The separation of waste at the sour-

ce is segregation at the point of generation, classifying them according to their characteristics to facilitate the collection chain, harvesting, registry and final disposal (Meng, Jiang and Li, 2014; MAE, 2015). Despite the obligation of the regulations, in the country only 37% of Municipalities comply with the separation at the source and of the 11 203.24 tons of solid waste collected per day, only 10% is collected differently from the source (INEC and AME, 2015).

The third phase is defined as temporary storage, which is the transitional waste deposit, maintaining conditions that ensure the protection and health of the natural and social environment (MAE, 2015). The next phase consists of treatment through recovery and recycling to extend its useful life (White et al., 2012).

The collection and final disposition of non-hazardous wastes is in charge of the Municipality and for the dangerous and/or special ones they must be transported and arranged with a manager, who has the respective permits (MAE, 2015). The final disposal is the permanent deposit of the residues in sanitary landfills, dumps or emerging cells (MAE, 2015). In Ecuador, the final disposal of waste is made in 39% in sanitary landfill, 26% in controlled dumps, 23% in open dumps and 12% in emergent cells (INEC and AME, 2015).

1.3 Environmental legislation in Ecuador

The legal framework in environmental management includes the Constitution of the Republic of Ecuador (2008), the Environmental Management Law (2004) and the Prevention and Control of Pollution Act (2004). In terms of waste, the Ministry of the Environment stipulates its provisions through Chapter VI of the Unified Text of Secondary Legislation of the Ministry of the Environment (TULSMA), issued in Ministerial Agreement 061 (MAE, 2015). This standard establishes as a national priority and of public interest the integral management of non-hazardous solid wastes and hazardous and/or special waste, dictating the minimum procedures and requirements for the management, storage and management thereof. This Ministerial Agreement refers certain guidelines to the Ecuadorian Technical Standards (NTE) 2841: 2014-03 and 2266: 2013 (INEN, 2013, INEN, 2014).

According to the Organic Code of Territorial Organization, Autonomy and Decentralization (CO-

OTAD), the municipal GADs are responsible for waste management within the area of their jurisdiction and their management is subject to the issuance of Ordinances. The policies that are established must be carried out under a comprehensive concept through a preventive approach minimizing the generation of waste both in quantity and at risk for the natural and social environment. In Latin America and the Caribbean, 51.9% of municipalities have solid waste management plans to meet the demands of each city (Tello et al., 2010).

In keeping with management principles, Ecuador maintains a National Solid Waste Management Plan (PNGIDS) as a national initiative to promote more sustainable proposals for waste treatment, in order to reduce the volume of waste and impacts generated (WEM, 2013).

Since the PHG has a wildlife care area, operational activities are also framed within the Interministerial Health Waste Management Regulations (MAE and MSP, 2014).

Complementary to the above, in Ecuador is a requirement that works, activities or projects codify their hazardous and special wastes according to the National List of Hazardous and Special Wastes (MAE, 2012). Those who generate them must follow the procedures for Register of Hazardous and Special Waste Generators (RGDPE; MAE, 2008).

Once the breadth and importance of comprehensive waste management is highlighted and given the cultural and tourist value of the PHG, the situation of waste management in this institution is questioned. Therefore, the purpose of this study is to perform the diagnosis of solid waste management based on determining the generation of solid waste, verify its management based on the regulations and propose viable alternatives for an adequate management of the same.

2 Materials and Method

For the development of this study a mixed qualitative and quantitative research was carried out. A non-experimental longitudinal trend design was performed since all PHG residues were characterized for two months on a weekly basis (Hernández, 2014).

2.1 Area of study

The Guayaquil Historical Park is located at Av. Río Esmeraldas at the height of 1.5 km via La Puntilla, in an urban area of the Samborondón canton, province of Guayas (UTM coordinates WGS 84, 17 M 62587 m E; 9763005 m S; 4 M of altitude), as shown in Figure 1. It has an extension of eight hectares, bordering with houses and the West with the River Daule. The average annual temperature during the study period was 27.5 °C and precipitation 1039 mm. (INAMHI, 2016).

2.2 Determination of waste generation

To identify the type of waste, several visits to the PHG were made to obtain information from primary sources through observation of activities and tasks. A non-probabilistic sample was taken by trial to interview key actors in the PHG. Five interviews were carried out with the staff of the establishment (coordinators, cleaning staff and tenants of the food stalls) and an interview with the Director of Environmental Management of the GAD of Samborondón. The interviews were carried out between January and March of 2016. As a secondary source, the Integrated Solid Waste Management Plan of the Guayaquil Historical Park by Ecoeficiencia (2008) was used.

For the quantification of wastes, direct sampling was carried out by Castillo Pazmiño (2012). It was weighed weekly for 8 weeks (March and April), using a Taylor 3070 hanging scale, each bag of waste in the two designated collection areas (Collection and Quarantine Center) always respecting the safety measures and using the respective equipment of Personal protection (Fig. 2).

A Record Sheet was used with the following terms explained below (Table 1).

The data was tabulated and reported in a descriptive statistics graph that included the amount of quantified residues in each measurement week. The number of visitors was included for each week.

For the qualitative analysis of the wastes, the guidelines of the International Standard American Society for Testing and Materials (ASTM) D5231-92 (2008), adapted to the study area, were followed and the waste categorization of the Ministry of the Environment was used (2012;2015). This Standard is generally used for municipal solid waste and can be applied to landfills, waste processing sites and transfer stations. ASTM D5231-92 (2008) describes

the guidelines for measuring the composition of raw municipal solid waste by manually classifying them in a given period of time, which should be at least one week. In the present study, spot sampling (taking a sample at a given time and place) was carried out in the waste storage areas, considering the total amount of waste generated in the fourth week of measurements. Based on the classification of the Ministry of the Environment (2012, 2015), hazardous wastes such as biohazards, luminaires and batteries, special waste such as used vegetable oil and non-hazardous wastes among which are distinguished; (Non-recyclable), recyclable (plastic, glass, cardboard and paper), biodegradable (traces of processed and unprocessed food).

Each category was weighed and the result was analyzed by obtaining a percentage detail for each type of waste, expressed in a descriptive statistics graph.

Hazardous wastes (infectious, short-stabbing and chemical) from the operating room of the ZVS quarantine area were quantified in a timely manner (one-time) by recording their weight in kg. The anatomo-pathological wastes stored in the freezer were not considered because of the difficult measurement conditions.

2.3 Verification of integrated waste management

The environmental regulations applicable to the TULSMA Reform study, the Interministerial Regulations for the Management of Sanitary Wastes, NTE INEN 2841 and 2266: 2013 and the Environmental Activities Catalog (MAE, 2016) were considered. The articles were reviewed to evaluate their compliance in a matrix, to obtain a percentage result and a descriptive explanation of each phase of the integral management was made.

2.4 Proposed management measures

From the observations of the field phase and the systematization of the collected information, the hierarchy in waste management was proposed by Letcher and Vallero (2011) and measures were established for an optimal integral management of wastes based on the required by current environmental legislation.

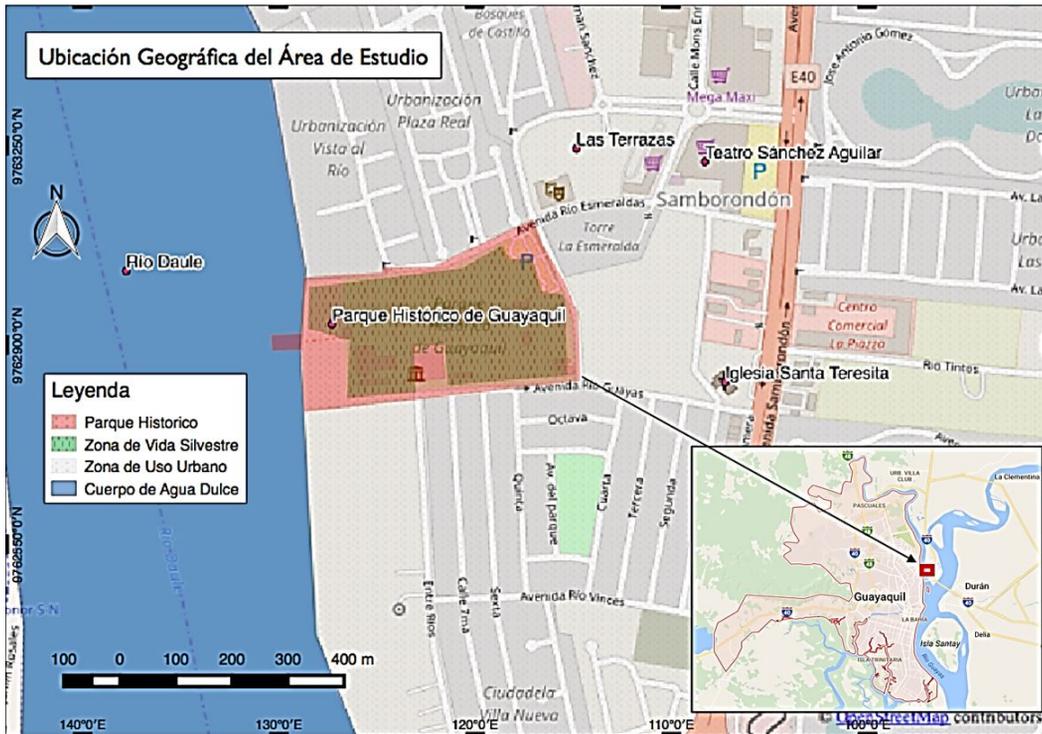


Figure 1. Area of study



Figure 2. A Record Sheet was used with the following terms explained below (Table 1).

Table 1. Record sheet format for weekly waste quantification.

Inorganic			Organic		
Bag No.	Weight	Observations	Bag No.	Weight	Observation

3 Results

According to the interviews carried out with different PHG actors, according to the Environmental Responsibility Specialist of the EPPUEP, the establishment does not have an environmental permit or hazardous and special waste generator registration (interview, January 28, 2016). The Head of the ZVS, indicated that the PHG currently has 310 individuals from 30 species. In addition, is responsible for the management of biohazardous waste, mentions that two years ago, wastes were delivered to an institution for final disposal, currently that is not done. Regarding fungicide and herbicide wastes, it was indicated that in the ZVS its use is prohibited, but that these products are used for pest and weed control in other areas.

According to the PHG Marketing Coordinator, during the months of January to April an average of one social event per week is performed, while from May to December the number is four per week (interview, March 08, 2016). According to the visitor registry for 2016, 22,565 people were received in January, 22,878 in February, 32,114 in March and 21,507 in April.

According to one of the cleaning staff, interviewed for their seniority in the PHG, in previous years there were activities of recycling and composting, however, these initiatives have not been permanent but are subject to change of administration (interview, March 14, 2016). One of the tenants of the food stalls in the PHG agreed that there was a more responsible management and mentioned that he has tried to replace the containers for the sale of food with others of cardboard; However, the value of the same was less profitable for the products sold (interview, March 27, 2016). The interviewed PHG staff agrees that staff are not trained on education and environmental management issues.

Regarding the final disposition, which is the responsibility of the municipality, the Director of Environmental Management of the GAD of Samborondón, indicated that at the moment pilot plans are being carried out to recycle jointly with some Samborondón institutions as part of a municipal initiative for the use and Waste treatment (interview, March 30, 2016).

3.1 Determination of waste generation

It was identified that the sources of waste generation correspond to the users and visitors of the PHG, as well as the activities of maintenance and cleaning of the facility. Visitors and users generate non-hazardous waste such as plastic containers (polyethylene terephthalate, high density polyethylene, cutlery, glasses, sorbets, bags), plastic packaging (cookie sheets or sweets), expanded polystyrene (plates, glasses), remnants of processed food, sanitary waste, and used napkins. Regarding the administration and cleaning activities, non-hazardous, hazardous and special residues were identified (Table 2).

In the maintenance of green areas, it is common to identify empty containers of fungicides or herbicides, which depending on their characteristics, can be considered as special because of their chemical content. The PHG indicated that the use of these products is subject to budget availability so there are times when their purchase is postponed or used to a lesser extent. During the study period, this type of waste was not found in any of the areas. In reference to what was mentioned, the products were not identified as inputs, so it was not possible to verify their characteristics and thus to identify if the containers could belong to the category of special.

The results of the quantification of non-hazardous waste in the PHG show that the average generation is 452 kg and is higher in the Collection Center than in the Quarantine Area. In the Collection Center the measurements had a direct relation with the number of visitors except for week 6, where the high amount of waste was generated by a social event in the PHG. In week 4 there was holiday in the city, which implies a greater number of visitors. The per capita production of waste was estimated at 11 grams per day, a fluctuating value, since not all visitors consume food in the PHG.

In the Quarantine Area, animal food remains, food containers for the staff, as well as office supplies and obsolete materials are deposited corresponding to the internal management of the PHG and is independent of the number of visitors. The largest generation of waste was given in week 4 with 137 kg in which were found office supplies, papers, folders, and furniture scraps associated with office cleaning. Residues of fruit and vegetable stalks were also observed, which registered greater weight compared to discarded husks or seeds the remaining weeks. The weekly results of waste

Table 2. Types of waste generated by PHG management and maintenance activities

NON-HAZARDOUS WASTE		
Recyclable	Organic	Non-recyclable
Paper, folders and other office supplies.	Remains of processed foods	Expandable polystyrene material.
Cardboard / Boxes (fruit reception)	Remains of animal feed (shells and pulps)	Sanitary waste (from bathrooms)
Sacks	Wastes from the preparation of food for sale (husks and pulps)	
Remains of cages and other metallic materials	Pruning: leaves and branches	
Wood remains	Wood	
Wood remains		
HAZARDOUS WASTE		
Infectious: Biological (gauze, dressing gloves, contaminated with bodily fluids of animals), Anatomopathological (viscera, parts of the body of animals by surgical procedures), short-pricks (needles, scalpel leaves contaminated with dangerous substances or secretions), Corpses or anatomical parts of diseased animals.		
Chemicals: pharmaceuticals (expired drugs, out of specification).		
Ink Cartridges		
Used batteries		
Luminaries		
HAZARDOUS AND SPECIAL WASTE		
Vegetable oils used in food frying processes		

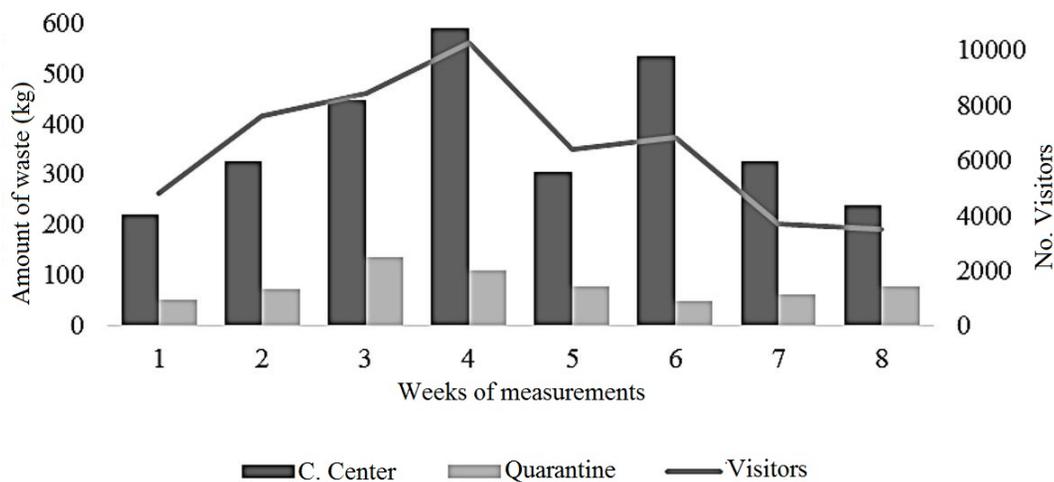


Figure 3. Quantification of wastes generated weekly in the PHG during the study period. The line shows the number of visitors per week. During the visit there was a social event.

quantification are shown in Figure 2.

The hazardous and special wastes recorded a weight of 7.5 kg and 20 kg respectively, considering that a specific sampling was carried out.

In Figure 4, the amount of waste generated according to the type is presented. The results of the determination of waste by category correspond to Non-hazardous 83%, special 12% and dangerous 5%. The results coincide with what is determined in the literature, because in Samborondón, 60 to 80 tons of garbage are generated daily. Of these, 20 tons correspond to organic waste (Autonomous Municipal Decentralized Municipal Government of Canton Samborondón, 2015). Other studies in Ecuador and Latin America state that between 50% and 60% of waste is organic (Mayorality of Bogotá D.C., 2012, Castillo Pazmiño, 2012, INEC and AME, 2015). As for recyclables, they can fluctuate between 10% and 30% and generally non-recoverable ones reach a magnitude of 20% to 30% (Aguilar et al., 2011; Saldaña et al., 2013).

3.2 Verification of environmental management with respect to waste management

Regarding the provisions of the current environmental regulations, 70 articles and aspects of the referred laws were evaluated. From this, 36% of compliance and 64% of non-compliance were determined (see Annex 1).

The PHG does not have an environmental permit or a regulatory process in place for its activity. According to the MAE Activities Catalog, the park could frame its wildlife exhibition activities within the category Construction and/or operation of zoos corresponding to an Environmental Registry; In addition, the category Construction and/or Operation of Parks, Sports Centers, Recreation and Leisure Places corresponding to Environmental Certificate would be included within the environmental permit.

Regarding the integral management of non-hazardous solid wastes and/or wastes, it is evident that the PHG is responsible for waste management from generation to delivery to the municipal collector. Despite this, there are no initiatives to reduce, minimize and eliminate the amount of waste generated. Dispensers for separation at the source were evidenced but a record of the amount of waste or its delivery to the collector in a classified manner is not

maintained.

As for the separation at the source, there are 41 bins, which are marked with different colors: 10 green for organic waste, 8 blue for plastic and glass and 4 gray for other waste.

As required by the NTE, it complies with the blue color for recyclable and green for organic, but it is not met with black for non-recyclable waste, red for hazardous and orange for special. It was observed that the containers do have a plastic sheath, are constructed with resistant materials and have capacity proportional to the volume of generation. However, it was evidenced the use of red cases for non-hazardous waste, and the use of this color corresponds to hazardous waste (Fig. 5).

It was evidenced that the bins are accessible to the public and that they are the minimum required for the sector to which the PHG (tourism) belongs. The containers could be relocated strategically to favor segregation in a more efficient and realistic manner. Of the total of bins located, 46% lack signaling, which prevents proper segregation. The labeling of the bins is not always in a visible place and some are worn. The logos used for the signaling of each bin are not those established by the NTE and are the same for all categories, which is not favorable for a correct separation at the source (Fig. 6).

Regarding the parameters of temporary storage, there are sites destined for the collection of wastes: Collection Center and Quarantine Area. The two areas lack signaling, roofing, waterproofed flooring. There is no differentiated storage of waste according to its characteristics or type.

In the Collection Center, the waste generated by visitors and users is deposited during the tour, in the bars and bathrooms. For this, there is a metal container of 7m³, with adequate capacity for the stored wastes but it lacks a lid which is inconvenient in case of rain because it accumulates the water and attracts vectors.

In the container of the quarantine area are deposited animal food waste (balanced, fruit remains), fish viscera, administrative waste as office supplies, cardboard, food containers and traces of processed foods. The container is of 4 m³, of resistant material and of suitable capacity (Fig. 7). Although it has a cap, it was evidenced that rainwater is filtered, and floods the bottom, which causes bad smell and is a potential source for attracting vectors (Fig. 8).

It was noted that the wastes were kept in the designated areas and none was left on the public

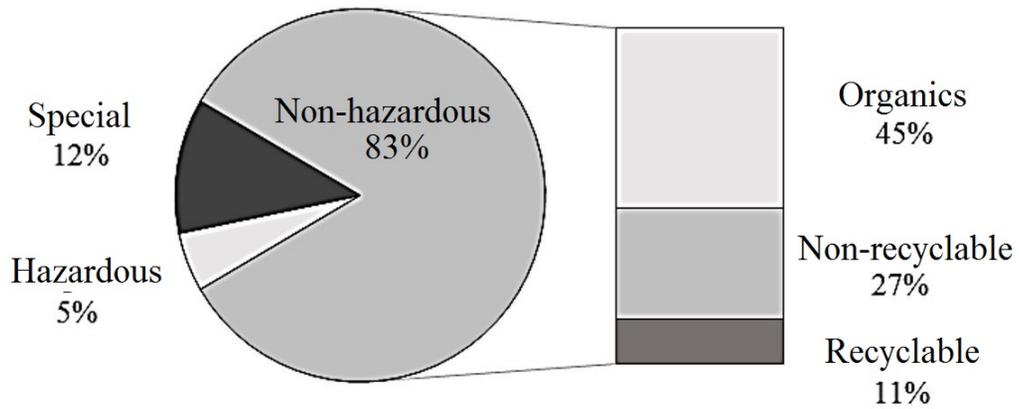


Figure 4. Qualitative identification of the wastes in the Guayaquil Historical Park from the data taken for the qualitative identification in the study period.



Figure 5. Red cover used in plastic container for the collection of plastic waste.



a)



b)

Figure 6. Bins located for classification in the source: (a) Bins devoid of signaling; (B) Logos of the bins



Figure 7. Non-hazardous waste storage area (a) Collection Center; (B) Container at the Collection Center



Figure 8. Container in the Quarantine Area

highway. As an external management it is known that the collection is a responsibility of the GAD of Samborondón, the same that must establish routes, schedules and frequencies. Despite this, the collection was not constant in the days and the schedule, which causes uncertainty for the institution and the difficulty of waste management.

Regarding the use or treatment, a non-compliance with the standard was evidenced, since during the study period it was evidenced that organic waste is not available in the composting area. At the reconnaissance visit, it was indicated that, currently, the machine that prunes the pruning material is not operative due to problems in its engine, which implies that these residues are not being used but are collected and delivered to the municipal collector (interview, 25 Of February 2016).

Regarding the final disposal, all wastes are delivered to the municipal collector to be deposited in a dump of the GAD of Samborondón, located in Cerro Santa Ana, Cantonal Header of Samborondón.

Regarding the integrated management of hazardous and/or special waste, PHG does not use waste classifications according to the current environmental legislation, it does not have the Hazardous and/or Special Waste Generator Registry (RGDPE); neither are there measures for the reduction and minimization of these wastes.

As for the storage of hazardous sanitary waste, it is performed in the operating room area, within the Quarantine Area of the ZVS. It is a roofed, wide, isolated site of operations and other activities but lacks signaling and restricted access (Fig. 8). The waste is stored in empty containers of alcohol, they are plastic but do not have enough rigidity for the type of waste, especially for cutting objects as well as lack signaling. The anatomic-pathological wastes, corpses and remains of animals are kept in freezing until their management (Fig. 9). Some hazardous and special wastes were collected together with the common residues (Fig. 10).

On the transfer and final disposition of the special and dangerous wastes, a management according to the standards is not evident. Special waste such as oil, luminaires and batteries are delivered to the municipal collector and have final disposal in the municipal dump. Biohazardous wastes have not been delivered for two years, exceeding the storage period set by the authority.

3.3 Management recommendations

General measures were suggested for an ideal waste management according to the phases of integral waste management. The need was identified for the PHG to establish a higher budget and to be specific for integrated waste management, as well as periodic training for PHG staff, the establishment of an internal procedure for the proper management of solid waste and the development of a brief induction for visitors on waste management. Table 4 describes measures for the integrated management of non-hazardous wastes and Table 5 for hazardous and special wastes.

4 Disucussion and Conclusions

In Latin America and the Caribbean, 51.9% of municipalities manage waste through a comprehensive management plan, Ecuador does not do so despite the fact that the regulations are rigorous and explicit (Tello et al., 2010; MAE, 2015). In practice there is a lack of implementation of policies that verify this compliance, for example, the Municipality of Samborondón does not have a Waste Management Ordinance.

The wastes identified in this study correspond to the categorization of legislation but there is an inadequate classification given that some are not considered as special (used vegetable oil) or dangerous (luminaire) (MAE, 2015).

The qualitative identification of the wastes generated in the PHG coincides with that of Ecoeficiencia (2008), except that in the period of this study no containers of fungicides, herbicides or agricultural inputs were found since they were not used in those months. The amount of waste reported by Ecoeficiencia (2008) was 130 kg daily, considering reference values given by the personnel, a value that differs from the quantification of 452 kg/week performed in this study. The difference could be attributed to the methodology of data collection. Another cause could be related to the increase of visitors due to the free admission to the park.

The organic wastes recorded greater weight in the Collection Center and in the Quarantine Area, results that agree with the 50% reported in other analyzes of waste characterization (Mayoral of Bogotá D.C., 2012, Castillo Pazmiño, 2012). The recyclables correspond to 11% and the non-recyclables to 30%, in agreement with Aguilar et al. (2011) and

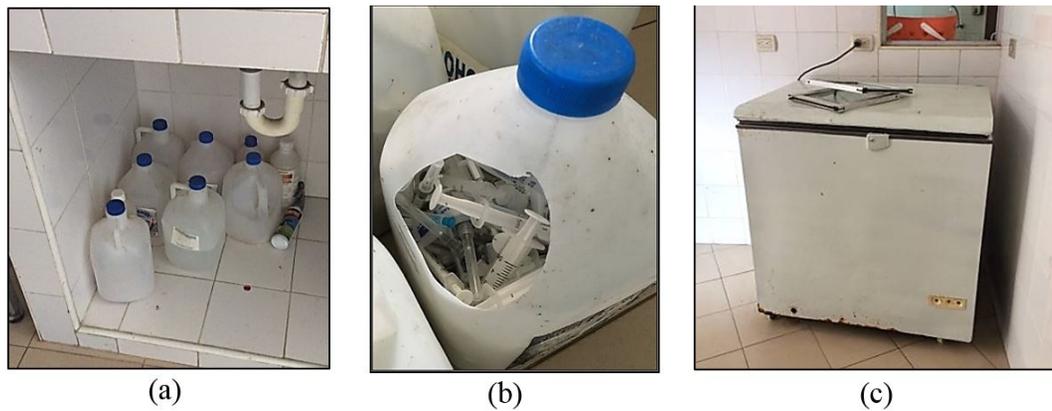


Figure 9. Storage of biohazardous wastes in the quarantine area (a) Area designated for the storage of biohazardous wastes; (B) Containers used for the storage of short-stabbing wastes (c) Container for storage of anato-pathological waste



Figure 10. Finding of hazardous and special wastes in non-hazardous waste storage areas (a) Luminaire at Collection Center (b) Used vegetable oil found in a weekly measurement (c) used Gloves and gauze in sheath found in the container Quarantine area

Table 3. Measures for integrated management of non-hazardous waste

NON HAZARDOUS WASTE		
	Proposed measure	Viability
Generation	Replace plastic food containers with cardboard or biodegradable ones and limit the sale of water in plastic bottles in bars, installing drinking fountains along the park in strategic locations	The change of packaging implies an increase of 20 - 30% in the cost of product. The water fountains do not require modification for their installation but investment for maintenance. There may be skepticism by visitors to drink non-bottled water.
	Personnel could use reusable containers to avoid discarding in each use. Return fruit and vegetable cardboard containers to the supplier. Incorporate food scraps into composting.	It is feasible, making staff aware of the benefit of this change. The supplier can also benefit because it does not incur another investment. Space is available and the practice was already realized and the product could be sold but it requires constant supervision.
Storage	Improvement of the signaling of bins. Provide bins for organic to the tenants of food stalls. Establish a site for the collection of recyclables. Adapt the collection area according to the regulations	It requires minimum investment but there may be budget constraints. The adequacy of the site does not require a significant investment although there may be a budget constraint.
Collection and final disposal	Non-hazardous waste recyclable through: work with the MAE Recycler Partner program, delivery to the municipal collector, as part of the SADG Pilot Plan of Samborondón or sale to authorized managers.	It would require interinstitutional support but the sale would allow an additional income to be collected for the PHG.

Table 4. Measures for the management of hazardous and special waste

HAZARDOUS AND SPECIAL WASTE		
	Measure	Viability
Generation	Obtain RGDPE	It implies knowledge about the subject or the contracting of professional services
Storage	Categorize and separate wastes Acquisition and maintenance of guard-type containers, as well as containers for disposing of infectious waste.	It involves training staff in this differentiation. Minimal Investment. This implies training for handling Hazardous and Special Wastes
	Have a specific site for the storage of hazardous and special waste, the same that meets the minimum requirements of the standard. Do not store this waste for more than 12 months.	There is space available for the storage of hazardous and special waste, but it would require training of personnel in the handling of such wastes.
Collection and final disposal	Deliver hazardous and special waste to an authorized MAE manager.	It is viable because there are managers authorized by the MAE in capacity to dispose this type of waste. It implies establishing a budget for management.

Saldaña et al. (2013).

Castillo (2012) suggests that, when quantifying by weight, a volumetric analysis is added so that the quantity recorded is tangible and justifiable when establishing management policies that is what happens in the PHG since the amount of daily per capita waste is minimal because the waste is light but bulky.

The weight generated per capita in the PHG is relatively low when compared to the daily 0.59 kg per capita estimated by the INEC and the AME (2015) at the municipal level considering that the PHG is a tourist destination. Regarding management, similar shortcomings were identified as determined by Ecoeficiencia (2008).

Regarding the PNGIDS approach, there is no compliance with the failure to consider the phases of integral waste management or treatment alternatives to give them added value and extend their useful life (MAE, 2013, 2015). A possible alternative would be to implement an energy recovery project from the treatment of organic material that can generate income (Melikoglu et al., 2013).

Villamagua (2016) mentions that there is a 72% non-compliance with the different regulations applicable to the management of hazardous waste in veterinary clinics in Guayaquil, a similar situation occurs in the Quarantine Area of PHG.

In short, the environmental impact of waste generation in the PHG should not focus on quantity but on its type and management. The perspective of the waste concept must be modified, not as an object without utility, but as an opportunity to create a product with added value. The PHG has the infrastructure and potential to become a replicable management model.

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ANNEX. Assessment of environmental management according to legislation

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
TULSMA (Ministerial Agreement 061)			
Chapter II: Unique System of Environmental Information			
Art. 14. Projects, works or activities contained in the national catalog, which generate impacts, must be regularized through SUIA			Does not have environmental regulation
Chapter VI: Integral Management of Non-Hazardous Solid Waste and Hazardous and / or Special Wastes			
Article 51. National technical standards for the integral management of non-hazardous solid waste, hazardous and / or special waste. To maintain standards for proper management and control.			Some aspects of the standards are complied with (see the evaluation below).
Section I. Comprehensive Waste and / or Non-Hazardous Solid Waste Management			
OF THE GENERATOR			
Art. 60. Generator Responsibilities and Prohibitions			
They are responsible for waste management			The institution is responsible for its waste until delivery to the municipal collector.
There are initiatives to reduce, minimize and eliminate the generation of waste			The Waste Management Plan carried out for this purpose in 2008 is not applicable
They perform classification in the source			There are pans separated by categories; It should be mentioned that the signaling is partial.
Records of generated / delivered wastes are maintained			Since 2008, a model for recording the amount of waste has been proposed; However, it is not performed.
Classified waste is delivered			No waste is classified. The delivery is done to the municipal collector.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
Hazardous waste is deposited along with non-hazardous waste			Hazardous waste was found: luminaires in the common waste container. Biohazardous wastes are maintained in an independent area.
OF THE SEPARATION AT THE SOURCE			
It is separated at the source			There is no separation at the source. There are different bins; However, the characterization is partial.
OF TEMPORAL STORAGE			
Art. 63. Temporal Storage Parameters of Non-Hazardous Solid Waste			
Containers are closed or have a lid			The container in the quarantine area has a lid. The container in the general area is not covered.
Containers are identified			Some are identified; However, most lack signaling. This difference is not respected.
Containers are with plastic sheath			All bins have plastic sheaths.
Containers are properly located			There are several pots on the route and in the area of bars, which allows depositing the wastes where they are generated.
The capacity of the pots is adequate according to volume generated			No se observó que los tachos estuvieran sobre saturados.
Construidos con materiales resistentes			The bins are made of wood. They are resistant, but some require repair
Containers are identified according to type of waste			There are no differentiated collection of waste containers.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
Art. 73. Of taking advantage			Currently no waste is used in composting or recycling activities. Organic and recyclable wastes are delivered to the municipal collector.
Article 74. Treatment			Currently no waste is used in composting or recycling activities. Organic and recyclable wastes are delivered to the municipal collector.
Section II. Comprehensive Hazardous and / or Special Waste Management			
Art. 88. Responsibilities of the generator of hazardous and / or special waste			
They have been registered as generator of hazardous and / or special waste			No
Measures have been taken to reduce / minimize Hazardous and Special Wastes			It is not done. However, minimizing hazardous waste is complicated, since they are essential to generate and are subject to the number of animals.
Dangerous and Special Wastes are stored under technical conditions of safety			There is a Hazardous and Special Waste area within the operating room area where these wastes are stored. Storage is not carried out according to INEN standards.
The delivery of Hazardous and Special Waste only to managers with environmental permission			Biohazardous waste has not been managed for 2 years. Other hazardous and special wastes are delivered to the municipal collector.
The single manifest is completed, formalized and safeguarded			They do not make Manifests.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
The annual declaration of generation, transfer and storage of Hazardous Wastes is presented			No
A record of entry and exit movements of Hazardous and Special Wastes is maintained			No
Storage			
Waste is packaged, stored and labeled according to technical standards			The packaging and storage is not optimal. Lack of signaling
The storage period should not exceed 12 months			The period is exceeded. Hazardous Waste has not been managed for more than 18 months.
The space is wide			There is enough space to maneuver and transfer waste.
It is separated from other areas			The area is separated from the rest.
Hazardous waste is stored next to Chemicals			No waste is stored next to chemicals.
Has restricted access			While the quarantine area has restricted access, the operating room doors remain open to staff.
They have emergency equipment, a contingency plan and trained personnel to apply it			They do not have emergency equipment or contingency plans. The staff mentions that they have not received training in hazardous waste management.
Installation with waterproof floor and smooth finish			The floor is tiled.
It is roofed			Yes
Signed with danger signs			There is no signage in the waste containers or in the area.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
The transfer of waste is carried out with a manager			The waste was taken to the disposal site by the PHG's own staff.
Log book of movements (logbook)			This record is not kept
The site where the final disposal was made, had environmental permission			This task is not performed.
REGLAMENTO INTERMINISTERIAL DE GESTIÓN DE DESECHOS SANITARIOS			
Ensure sustainability of integrated management of sanitary waste generated in its institutions. Budget allocation.			There was no evidence of a comprehensive management plan.
Comply with the comprehensive management phases			There was no evidence of a comprehensive management plan.
Develop a comprehensive management plan.			They have a baseline (Ecoeficiencia, 2008) however, their implementation is not observed
Physical infrastructure and materials suitable for comprehensive management			The infrastructure is able to be adapted according to the needs for an integral management.
Dangerous and Special Waste Generator Log			They do not have this permission
Personnel trained for internal management			The staff mentions that they have not received training in hazardous waste management.
Establish committee.			There is no committee for compliance with the Comprehensive Management Plan
Annual statement			Not performed
Deliver and maintain Unique Manifests			No records are kept.
Internal management. Disposition in red containers and bags. Common wastes in covers and black containers.			Generally, it is according to the norm. However, the use of red covers for common residues was observed.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
Separation at the source and conditioning in resistant sheaths and containers. NTE-tagged and non-compacted.			They are stored independently. However, the NTE is not met.
Infectious wastes: Segregate condition and label in resistant, drip-proof red cases. Storage in refrigeration to maximum 4 degrees. Deliver to authorized managers or GAD.			They have a freezer, arranged for this purpose.
Sharp objects: in well-identified, labeled and puncture-resistant containers, properly identified and labeled. In the case of vaccination campaigns, extra-hard, thermo-laminated cardboard containers may be used.			Empty alcohol containers are used to store wastes.
Wastes from carcasses: segregate, condition, label in drip-proof red cases in cold rooms at max. 4 degrees. Deliver to managers.			They have a freezer, arranged for this purpose.
Chemical waste segregate in source. Condition and handle according to instructions on labels, MSDS sheets. Return to distributor or supplier, in charge of management.			There are no safety sheets, labels and no return to the supplier.
ECUADORIAN TECHNICAL STANDARDS			
5. Requirements			
5.3 Temporary storage and collection centers			
Waste separated at the source by stations with colored containers, accessible to people.			There are containers to make separation in the source although it is not executed in full. It was evidenced that several pots lack signage. The bins are distributed throughout the PHG, are accessible to the public

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
Tourist sector, Public sector: station with colored containers in busy areas.			Colored containers are kept in crowded areas.
Tourism sector, public sector: at least recyclable, non-recyclable and organic in internal areas.			The internal storage area is separated according to the type of waste
5.4 Labeling			
Label in visible place, with characters legible and according to NTE INEN 878.			There are some bins that lack signage and others do not keep it in a visible place. The color is adequate in most bins but the logo is not the one established by the standard. The internal collection area lacks this labeling.
Name of waste, logo and distance of observation, according to NTE INEN ISO 3864-1			The logos are not those established by the standard.
6. Color code			
6.1 General classification			
Blue color for recyclable waste			The containers hold blue signage for plastics and glass.
Black color for non-recyclable, non-hazardous waste			The sign of these containers is gray
Green color for organic waste			It is green for organic.
Red color for hazardous waste			This color is not maintained for hazardous waste.
Orange color for special waste.			type of waste is not segregated
6.2 Specific classification			

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
Maintaining green containers for organic waste includes: biological waste, food scraps, fruit peels, vegetables, leaves, among others			Signage maintains this color but there is no proper segregation of organic waste.
Keep black containers for non-recyclable waste includes: diapers, sanitary napkins, used napkins, adhesive paper, toilet paper, paperboard with oil waste. Plastic containers of edible oils, containers with food scraps.			Non-recyclable waste is deposited in containers with gray signage. This classification is called "Other"
Keep blue containers for recyclable waste: useable plastic, multi-layer containers, PET. Clean empty plastic bottles of water, yogurt, juices, soda, etc. Plastic covers, covers of milk, clean. Shampoo containers or clean and empty cleaning products.			The coloration of the signage for this type of waste is blue. However, there is an incorrect segregation at the source so that other wastes in addition to plastics were entered in the containers.
Keep white containers for type of waste glass or metals including: glass bottles, soft drinks, juices, alcoholic beverages. Aluminum jars, tuna cans, sardines, preserves, beverages. Vacuums clean and dry.			There is no separate classification for this type of waste. According to current signage, glass waste is deposited in plastic containers.
Keep gray containers for paper and cardboard waste. Among them: clean paper in good condition, magazines, advertising brochures, boxes and cardboard and paper packaging.			The gray coloration is maintained for containers categorized as "Others".
Keep orange colored containers for special waste such as debris, tires, furniture, and electronics.			These wastes are not segregated. These containers are not available.

EVALUATION OF LEGAL COMPLIANCE			
Aspects of environmental legislation (summary)	Compliance		Observations
	Yes	No	
6.1.5. Labeling. Requirements for labels and hazard labels			
6.1.5.1 Labels for the identification of packagings			
They must be of materials resistant to handling and inclement weather.			There are no labels or danger signs.
TOTAL	25	45	
TOTAL EVALUATED	70		
Percentage	36%	64%	